

What is claimed is:

1. A parallel plate diode, comprising:

metal electrodes and semiconductor materials contacting said metal electrodes, wherein the two thin plate electrodes made of metal disposed in parallel, and a layer of thin plate semiconductor material sandwiched between the two thin plate electrodes, the concentration of the carriers in the semiconductor material layer is 20% or less than that of the electrons in the metal, one of the metal electrodes is made so as to have a plurality of recesses from its surface into the interior on the side that faces the semiconductor coat layer, the diameter of those recesses is less than 4 micrometers.

2. The parallel plate diode according to claim 1, wherein said recesses are well-shape cavities.

3. The parallel plate diode according to claim 2, wherein said cross section of the well-shape cavity is a circular, a square, rectangle or an irregular curve.

4. The parallel plate diode according to claim 2, wherein said cross section of the well-shape cavity is groove-shape.

5. The parallel plate diode according to claim 2, wherein said cross section of the well-shape cavity is in the form of an array of projections in which convex portions and concave portions are staggered each other.

6. The parallel plate diode according to previously any one of claims, wherein said two walls of the well-shape cavity or groove-shape are made of two substances, $e\Phi_1$ and $e\Phi_3$ respectively represent the power function of the two walls of the well cavity, they satisfy the following relation:

$$\Phi_1 < \Phi_3$$

7. The parallel plate diode according to claim 1, wherein said substance between said metal electrodes is a substance of weak conductivity.

8. The parallel plate diode according to claim 1, wherein said parallel plate diode is attached to the insulated substrate.

9. The parallel plate diode according to claim 8, wherein said parallel plate

diode is attached to glass substrate.

10. The parallel plate diode according to claim 9, wherein said metal electrode having the well-shape cavity of each diode is coupled to the germanium electrode of the adjoining diode having the same structure, thus forming a parallel plate diode in series structure.

Sub A1 11. The parallel plate diode according to claim 1 or 2, wherein said metal electrode is made by kovar-alloy.

Sub B1 12. The parallel plate diode according to claim 11, wherein said each of the kovar-alloy electrodes having well-shape cavities of such diodes can join the kovar-alloy substrate of the other diode having identical structure so that they form a parallel plate diode in series.

Sub A2 13. The parallel plate diode according to claim 1 or 2, wherein there are recesses on the surface where the two metal electrodes that make up the parallel plate diode contact the semiconductor material, wherein average diameter of the recesses on one side is equal to or smaller than 0.7 micrometer while the average diameter of the recesses on the other side is bigger than 0.7 micrometer.

Sub B2 14. The parallel plate diode according to claim 13, wherein said the surface of the two electrodes have recesses with different depths.

15. The parallel plate diode according to claim 13, wherein said the surface of the two electrodes have recesses with different shape.

16. The parallel plate diode according to claim 1, wherein said layers of materials are parallel to each other, there is no restriction on the overall shape formed by said different layers.

Sub P3 25 17. The parallel plate diode according to claim 1 or 13, wherein said semiconductor material is liquid semiconductor material.

18. The parallel plate diode according to claim 1 or 13, wherein said semiconductor material is high resistance metal alloy.